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A

# LETTER

TO THE

RIGHT HON. WILLIAM PITT,

CHANCELLOR OF HIS MAJESTY'S EXCHEQUER,

WHEREIN IS DEMONSTRATED,

BY VARIOUS ARITHMETIC CALCULATIONS,

THE INJURIES THAT HAVE ARISEN,

*AND WILL CONTINUE TO ARISE,*

TO THE

BANK OF ENGLAND,

TO EVERY

PUBLIC OFFICE,

TO

FUNDED PROPERTY,

TO

COMMERCE,

TO

AGENCIES,

AND TO THE

NATION IN GENERAL,

FROM THE PRESENT ERRONEOUS METHOD OF

CALCULATING INTEREST ON MONEY.

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LONDON:

PRINTED FOR J. STOCKDALE, PICCADILLY, M DCC XCIV.

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Gratis

*This Day is published,*

[PRICE, BOUND, TEN SHILLINGS AND SIX-PENCE,]

A

# NEW BOOK OF INTEREST,

CONTAINING

## ALIQUOT TABLES,

TRULY PROPORTIONED TO ANY GIVEN RATE,

COMPILED FOR THE USE OF THE

MERCHANT, BANKER, PUBLIC OFFICES,

And all other Persons concerned in INTEREST ACCOUNTS,

WHEREIN IS DEMONSTRATED,

BY VARIOUS ARITHMETIC CALCULATIONS,

That the Tables in all the common INTEREST Books, constantly make the  
INTEREST LESS than the true Amount,

And that a Perseverance in their Use, or calculating by the PEN,  
On the Principles they are composed, will, in all Instances, prove injurious

TO THE

PUBLIC REVENUE, to the BANK of ENGLAND,

To COMMERCE, to FUNDED PROPERTY,

To PUBLIC COMPANIES, to the INDIVIDUAL,

AND TO THE

NATION IN GENERAL.

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By WILLIAM WALLACE, COMMERCIAL ACCOUNTANT.

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LONDON:

PRINTED FOR JOHN STOCKDALE, PICCADILLY.

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Bound strong, 8 in thick  
not varnished

THE BOOK OF MARY

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A

LETTER, &c.

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SIR,

A New Book of INTEREST has lately been published, wherein Tables are introduced, calculated to the *aliquot* parts of time, and the given rate: These Tables, on inspection and comparison, are found to produce the amount of interest in all cases, different from what is given in the Books of Interest now in general use: This disagreement, alarming as unsuspected, seemed not undeserving that scrutiny it appeared to invite. The Introduction to this work already explains the principles on which these calculations are founded, and are doubtless satisfactory to the Merchant and Banker, for whose assistance that publication appears to be principally intended; but when the general injurious effects which must arise from these *two methods* of computation are discovered, the explanation there given will appear much too limited for the importance of the subject; I have therefore attempted a more clear and precise demonstration of the CAUSES OF THE ERRORS which exist in the common Interest Books, and the great national advantages which must arise from calculating Interest by Aliquot Tables, formed by the Rule of Practice.

B

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The Rule of Practice, which calculates by *Years, Months, Weeks, and Days*, forms the *aliquot Tables* lately published ; which method of computing Interest is nothing more than a renovation of what was heretofore pursued by our ancestors ; the truth of which would appear on examining the Interest Accounts in the Exchequer, South Sea and India House, Bank of England, and the private Banks, &c. previous to the year 1730 ; it will also be seen to correspond with the opinions of Sir William Lelly, Mr. Locke, and the most eminent Mathematicians of the last century, at which time *printed Tables* were things unknown ; but the gradual increase of paper credit and funded securities since that period, speedily demonstrated something more expeditious than the pen, and equally certain in its effects, for the acceleration of public business.

This general invitation soon produced various books for that purpose, which were implicitly received, and still continue in use ; and it is something singular, that in all these publications, the forms heretofore used, and *established by experience*, should be rejected, and spurious Tables substituted, calculating Interest to *Years, Months, and Days ONLY* ; and it is still more singular, that no reason is given for the omission of *WEEKS* ; no apology for the innovation, nor any prefatory matter to justify the calculations, and the novelty of the methods they have introduced.

But, notwithstanding this taciturnity in the several authors, they could not have been ignorant of the certain *losses* which constantly arise from the use of the Tables they have introduced ; *they undoubtedly thought them too trifling to deserve notice*, or they would not have escaped their correction, or at least their remarks, several of them being composed by *very*

very judicious accountants ; indeed, they appear to have discovered the fact, but not inclined to remove the errors, which they knew nothing but decimal operations could accomplish ; and as the several compilers seem to have intended them only for the mercantile world, and knowing that commerce pays no regard to *off reckonings*, being by long usage known to *give and take* the Farthing, they were not ignorant that decimals were incompatible to traffic ; therefore reconciling the present Tables to be as correct as vulgar arithmetic could make them, they appear to have thought them completely eligible to the purposes for which they were intended.

In this opinion they certainly would not have been mistaken, had they intended them to be used independently and irrelative to each other ; the Table for Months in their Books holding true *aliquot* ratio to [12], the months in a year ; and that of Days, a true *fractical* proportion to [365], the days in a year ; the first of these Tables thereby giving every solution of Interest *truly* proportioned to the different rates, and the latter as nearly so as can be produced by a fractional operation, or by that of the Rule of Three ; therefore when these Tables are used in their *single*, or *irrelative* state, commerce, and individual calculation will experience little grievance by a perseverance in the present method, and such partial application being seldom required in commerce, the injuries arising from their use in this *irrelative* state, may be supposed not deserving attention ; but in all cases of *congregate* time, when the Interest on MONTHS, and their *componant parts* are required, the *confederate* Interest arising from the Table of Months and Days will discover a loss not undeserving the notice of the most opulent trader.

Were the effects which appear from the use of the common Interest Books confined to *commerce*, the proofs already given of their inaccuracy in the Introduction to these new Tables, might have, perhaps, been thought satisfactory; but they are clearly seen to extend their injurious consequences to every *species of Finance*, all *Government Securities*, *Funded Property*, the *National and Private Banks*, *Public Companies*, *Agencies*, *Individual Property*, and to *pervade the kingdom in general*; they therefore appeared to require not only a more general discussion, but to look forward to the most distinguished and judicious character in the kingdom, for such correction and reformation an evil of this magnitude might be found to demand; it is therefore, Sir, I have the honor, with the greatest deference, to submit the following remarks to your perusal.

Before I enter on a demonstration of the correctness and superiority of an *aliquot* calculation, on which the present **NEW TABLES** of Interest are established, it appears necessary to shew the inaccuracy of the *common TABLES* of Interest, and the losses sustained by their use, for which purpose the Two Tables contained in these Books shall be first considered as irrelative, and independent on, each other; and secondly, in their congregate state, or when they are required to be *compounded* with any parts of a year to which they may be analogous.

In the Tables for Months, the Year is divided into twelve parts, whereby the Interest on each number of months holds a clear and *aliquot* proportion to the given rate, as appears by the following Table of the Interest of 100l. at 5 per cent. for twelve progressive months.

TABLE

TABLE I.

Months	Interest.	Remainder.	Rate per An.	Difference.	
				£.	s.
1	0 8 4	0	5 0 0		0
2	0 16 8	0	5 0 0		0
3	1 5 0	0	5 0 0		0
4	1 13 4	0	5 0 0		0
5	2 1 8	0	5 0 0		0
6	2 10 0	0	5 0 0		0
7	2 18 4	0	5 0 0		0
8	3 6 8	0	5 0 0		0
9	3 15 0	0	5 0 0		0
10	4 3 4	0	5 0 0		0
11	4 11 8	0	5 0 0		0
12	5 0 0	0	5 0 0		0

The Interest for Months, which appears in this Table, is either found by the Rule of Practice, or by the Rule of Three; if by the former, the *aliquot* division of the required time is proportioned to a Year of Twelve Calendar Months; if by the latter, the first term of the stating contains [12], equal to the Twelve Calendar Months, whereby the ~~two~~ operations must always agree, and produce an Interest for the given *Months* exactly proportioned to the given rate.

But such aliquot ratio to the given rate will not be found in the Table of Days, because the calculations by which they are formed, not being in *aliquot* proportion to time, are not solvable by the Rule of Practice, necessity therefore requires an application to the Rule of Three; in which proceeding, 365, the Days in a natural Year, must be made the general divisor, and each Day in the Year being thereby made a *numerator* to the said divisor, the value of the fraction so answering, becomes the Interest for the time required;

ed ; or, in default of such proceeding, the said numerator must be made the *third term* in the Rule of Three, for finding the required Interest by a divisor of 365. This fact is confirmed by the following question :

Suppose the Interest on 100l. is required for Five Days, at 5 per Cent. per An.

By the first method  $\frac{5}{365}$  becomes the fraction, which, if valued as  $\frac{5}{365}$  of 5l. the Interest for a Year, will produce 1s.  $4\frac{1}{4}$ d.  $\frac{275}{365}$  : or if the *numerator* of the fraction, by the second method, is made the third term of the stating, it will also produce 1s.  $4\frac{1}{4}$ d.  $\frac{275}{365}$

Hence it appears, that this manner of calculating Interest on Days is as perfect as can be expected by *vulgar* Arithmetic ; but though it may be satisfactory in general commercial transactions, where the Interest on Days is only required ; it will, nevertheless, be proved incorrect, and productive of loss to the capital of the Trader ; and, notwithstanding it is true in the *premises*, it will be found false in its *conclusions* ; for tho' the Interest on 100l. for 365 Days is 5l. and shall produce 3 $\frac{1}{4}$ d. as the Interest for One Day ; yet the said Interest for One Day shall not produce 5l. the Interest of 365 Days, as appears by the following

#### T A B L E II.

of the Interest of 30 progressive Days, and the several rates per ann. thereby produced, and of the deficiencies or losses per cent. on each day's calculation.

*Days.*

Days.	Interest.	Remainder.	Rate per An.			Difference.	
			£.	s.	d.	s.	d.
1	0 0 3 $\frac{1}{4}$	55	4 18	10 $\frac{1}{4}$		1	1 $\frac{3}{4}$
2	0 0 6 $\frac{1}{2}$	110	4 18	10 $\frac{1}{4}$		1	1 $\frac{3}{4}$
3	0 0 9 $\frac{3}{4}$	165	4 18	10 $\frac{1}{4}$		1	1 $\frac{3}{4}$
4	0 1 1	220	4 18	10 $\frac{1}{4}$		1	1 $\frac{3}{4}$
5	0 1 4 $\frac{1}{4}$	275	4 18	10 $\frac{1}{4}$		1	1 $\frac{3}{4}$
6	0 1 7 $\frac{1}{2}$	330	4 18	10 $\frac{1}{4}$		1	1 $\frac{3}{4}$
7	0 1 11	20	4 19	11 $\frac{1}{4}$		0	0 $\frac{3}{4}$
8	0 2 2 $\frac{1}{4}$	75	4 19	9 $\frac{1}{2}$		0	2 $\frac{1}{2}$
9	0 2 5 $\frac{1}{2}$	130	4 19	8 $\frac{1}{4}$		0	3 $\frac{3}{4}$
10	0 2 8 $\frac{3}{4}$	185	4 19	7 $\frac{1}{4}$		0	4 $\frac{3}{4}$
11	0 3 0	240	4 19	6 $\frac{1}{2}$		0	5 $\frac{1}{2}$
12	0 3 3 $\frac{1}{4}$	295	4 19	5 $\frac{3}{4}$		0	6 $\frac{1}{4}$
13	0 3 6 $\frac{1}{2}$	350	4 19	5 $\frac{1}{4}$		0	6 $\frac{3}{4}$
14	0 3 10	40	4 19	11 $\frac{1}{2}$		0	0 $\frac{3}{4}$
15	0 4 1 $\frac{1}{4}$	95	4 19	10 $\frac{1}{4}$		0	1 $\frac{3}{4}$
16	0 4 4 $\frac{1}{2}$	150	4 19	9 $\frac{1}{2}$		0	2 $\frac{1}{2}$
17	0 4 7 $\frac{3}{4}$	205	4 19	9		0	3
18	0 4 11	260	4 19	8 $\frac{1}{2}$		0	3 $\frac{1}{2}$
19	0 5 2 $\frac{1}{4}$	315	4 19	7 $\frac{3}{4}$		0	4 $\frac{1}{4}$
20	0 5 5 $\frac{3}{4}$	5	4 19	11 $\frac{3}{4}$		0	0 $\frac{1}{4}$
21	0 5 9	60	4 19	11 $\frac{1}{4}$		0	0 $\frac{1}{4}$
22	0 6 0 $\frac{1}{4}$	115	4 19	10 $\frac{1}{2}$		0	1 $\frac{1}{2}$
23	0 6 3 $\frac{1}{2}$	170	4 19	10		0	2
24	0 6 6 $\frac{3}{4}$	225	4 19	9 $\frac{1}{2}$		0	2 $\frac{1}{2}$
25	0 6 10	280	4 19	9		0	3
26	0 7 1 $\frac{1}{4}$	335	4 19	8 $\frac{3}{4}$		0	3 $\frac{1}{4}$
27	0 7 4 $\frac{3}{4}$	25	4 19	11 $\frac{3}{4}$		0	0 $\frac{1}{4}$
28	0 7 8	80	4 19	11 $\frac{1}{4}$		0	0 $\frac{3}{4}$
29	0 7 11 $\frac{1}{4}$	135	4 19	10 $\frac{3}{4}$		0	1 $\frac{1}{4}$
30	0 8 2 $\frac{1}{2}$	190	4 19	10 $\frac{1}{4}$		0	1 $\frac{3}{4}$

On reference to this Table, the first six numbers are seen to produce the same rate of Interest, and consequently the same deficiencies; the cause of this uniform proportion clearly arises from the remainders being arithmetically *progressive*, viz. 55, 110, 165, 220, 275, 330; such remainders *increasing* as the numerators advance towards a year (the given integer), thereby making 365, the denominator of the several

several fractions ; hence, in valuing the deficiencies on these days, the *addition* of the remainders *decreasing* in proportion as the numerators *advance*, the products must be uniformly the same, for when the deficiency on *one* day is sought, the remainder 55, being 365 times repeated, will be found to produce the fraction  $\frac{20075}{365}$  equal to the deficiency,  $13\frac{3}{4}$ d. because one day is the  $1-365$ th part of a year ; but was the remainder, five days, to be valued, it would be as 5-365, or  $1-73$ d part of a year, and the remainder, in this instance, becomes increased in a *quintuple* proportion also, or to 275, and in like *ratio* the *addition* of 275 would abate, for such remainder would require to be but  $73$  times repeated to produce the fraction equal to the deficiency ; for if 275 is multiplied by the  $73$ , the *decrease* of the multiplier is seen to hold exact proportion to the *increase* of the remainder, and consequently produce the same fraction, viz.  $\frac{20075}{365}$  : This ratio is still further supported by the Rule of Three, for as the *numerator*, or number of days is to its respective remainder, so is the denominator, 365, to the numerator proportioned to such number of days ; hence, as 5 days are to 275, so will 365 be to 20075, which also gives the fraction  $\frac{20075}{365}$ , equal to  $13\frac{3}{4}$ d.

But tho' such uniformity arises from *one* to *six* days, it cannot continue from 7 to 13, by reason 35 are deficient [of 55] in the remainder [20], consequently the difference can only advance proportioned to the remainders increased from such abatement ; for at seven days, the deficiency, suddenly sinks to Three Farthings, and continues to increase to  $6\frac{3}{4}$ d. when at fourteen days, it sinks again to Three Farthings, and continues to increase to  $4\frac{1}{4}$ d. when it sinks to One Farthing ; in

this progression the remainders are seen to form correspondent revolutions, and the deficiencies to decrease, as the said remainders approximate to 365, their known denominator, wherein they become finally immersed. This clearly appears on reference to the Table, where the first remainder [55] increases in regular progression to its known denominator [365], wherein at every *sextuple* it becomes immersed, and the surplus given the remainder of the next division: At each of these immersions the *Interest* on the given time, is, on the succeeding day, seen to approach to the given rate of Interest, in proportion as the congregate numerators incline to be aliquot to their denominators; and were they uniformly so, there would never be any deficiencies, and consequently Interest for any required time would always be exactly proportioned to the given rate per annum.

To the want of an aliquot proportion in the preceding Tables, all the deficiencies are to be ascribed, and was a regular Table formed of the Interest of Money, for 365 successive days, similar revolutions would appear, with this distinction, that the remainders would at every *quintuple* be totally *immersed*; at which periods, the Interest for the *given time* would always be found exactly proportioned to the *given rate*, because the number of days would then be *exactly* aliquot to 365, their known denominator.

The days in a year which become *aliquot* to 365, in the *quintuple* before mentioned, are 73, 146, 219, 292, and the denominator, 365, makes the last. The following Table shews the Interest on 100l. at 5 per cent. for the said days, to be exactly proportioned to the given rate, by vulgar Arithmetic, and the common divisor, 365.

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TABLE

## T A B L E III.

The Interest on 73 days is £.1 0 0 }  
 146 - - - 2 0 0 } or £.5 0 0 per an.  
 219 - - - 3 0 0 }  
 292 - - - 4 0 0 }

There can be no greater evidence of the necessity and truth of an *aliquot* calculation for finding the Interest of Days, truly proportioned to the given rate, than what has hitherto been given. This last demonstration shews in the plainest manner, that all operations by vulgar Arithmetic, and the divisor 365, would proportion Interest exactly to the given rate, by the *Rule of Three*, did the third number hold true *aliquot* ratio to the first, and to the want of such concordance, the solutions thereby produced can never agree with the Rule of PRACTICE, but *will always make the answers less than the true amount.*

The CAUSES of the deficiencies in the calculation on days being thus clearly demonstrated, I shall bring forward the EFFECTS thereby produced from this, their *independent* or *irrelative* state; for which purpose, reference must be had to Table II. wherein it is seen that the *average* difference is nearly *five-pence per cent.* but this loss will arise only in such proportions as the given rate shall be found to bear to 365, for the Interest for one day on 100l. appears by the Table to be  $3\frac{1}{4}$ d. but it is impossible that on receiving  $3\frac{1}{4}$ d. there can be a loss of  $13\frac{1}{4}$ d. it must therefore arise in the proportion that *one* day bears to 365; in the investigation thereof, it is discovered that a *positive loss*, equal to the remainder [55] is produced on the Interest of 100l. for one day, and one day being as 1 to 365, it follows that the remainder [55] being 365 times repeated, will be increased to 20075, which becoming

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a numerator to 365, gives the fraction  $\frac{20075}{365}$ , equal to  $13\frac{3}{4}$ d. hence the true deficiency on one day is but ,150685 of a farthing.

In like manner should the deficiency on seven days be examined, it would appear that the *ratio* which seven days bears to 365 is 52 1-7th; therefore the remainder at seven days must be 52 1-7th times repeated, before the deficiency or loss of Three Farthings shall arise; if therefore 20 (the remainder) is so repeated, it gives the fraction  $\frac{1043}{365}$ , equal to Three Farthings. In further evidence of this fact, the following Table is introduced, shewing the number of times the Interest on any particular number of days shall be repeated to produce the deficiencies set against each day, and to render the said Tables still more intelligible, I have supposed the calculations produced from discounts, whereby the number of Bills (drawn at days) necessary to be discounted are shewn, that shall produce the deficiencies set against each number of days.

## TABLE IV.

If the Bank of England, or any Private Bank, discount Bills of 100l. at five per cent. from *One to Thirty Days*, there will be a loss of Interest on every

TABLE IV.

	<i>Deficiencies.</i>	<i>s. d.</i>		<i>Deficiencies.</i>	<i>s. d.</i>
365 Bills dif. at 1 day	1 1 $\frac{3}{4}$		22 Bills dif. at 16 days	0 2 $\frac{1}{2}$	
182	2	1 1 $\frac{3}{4}$	21	17	0 3
121	3	1 1 $\frac{3}{4}$	20	18	0 3 $\frac{1}{2}$
91	4	1 1 $\frac{3}{4}$	19	19	0 4 $\frac{1}{4}$
73	5	1 1 $\frac{3}{4}$	18	20	0 0 $\frac{1}{4}$
60	6	1 1 $\frac{3}{4}$	17	21	0 0 $\frac{3}{4}$
52	7	0 0 $\frac{3}{4}$	16	22	0 1 $\frac{1}{2}$
45	8	0 2 $\frac{1}{2}$	15	23	0 2
40	9	0 3 $\frac{1}{4}$	15	24	0 2 $\frac{1}{2}$
36	10	0 4 $\frac{3}{4}$	14	25	0 3
33	11	0 5 $\frac{1}{2}$	14	26	0 3 $\frac{1}{4}$
30	12	0 6 $\frac{1}{4}$	13	27	0 0 $\frac{1}{4}$
28	13	0 6 $\frac{3}{4}$	13	28	0 0 $\frac{1}{4}$
26	14	0 0 $\frac{3}{4}$	12	29	0 1 $\frac{1}{4}$
24	15	0 1 $\frac{3}{4}$	12	30	0 1 $\frac{3}{4}$

It appears by this estimate, that the aggregate number of Bills are 1447, and the average thereof 48 7-30th (say 50) Bills; it also appears, that the average loss or deficiency per cent. extracted from Table [2], is nearly Five-pence; hence it is clear, that in computing Interest from the common Table of Days, on Fifty Bills of 100l. each, or one single Bill of 5000l. there is a loss of Five-pence; and supposing the Bank of England makes a promiscuous daily discount of 50,000l. on Bills *drawn at days only*, the Interest calculated for such discount, would, in the proportion of Five-pence to 5000l. cause a daily average deficiency of 4s. 2d. and allowing 313 office days in a year, the annual loss would be 65l. 4s. 2d.

This small loss on so capital a sum, may, perhaps, not be thought deserving attention; it nevertheless clearly supports my original position, that **ERROR** exists in the present Table for Days; and although the deficiencies in the Interest for the

the discount of Bills at Days, may be thought of little import, yet when required for Foreign and other Bills, or for standing or current Accounts, wherein *the broken parts of a month* may be expected to arise, the *loss* will be as alarming as unsuspected, and in this *latter state*, the Table for Days will always be seen to embarrass and confound that calculation it is expected to liquidate and explain.

The Table for Days has no advocate but custom, and that custom unsupported by evidence; no COMPILERS have attempted to prove that the calculations they have introduced in their Tables for Months and Days, are proportioned to the same integer, although they must have been conscious that in default of such concordance, their solutions, whenever *confederated*, would be always disproportioned to the given rate; if, on the contrary they considered them merely *independent*, and *irrelative* to each other, they must have intended that all *TIME* should have been brought into *Days* or into *Months*, before their solutions were sought in the respective Tables; such proceeding would, undoubtedly, have made them answer sufficiently near for the purposes for which they appear to have been separately intended, could it have been practicable; but the former being incompetent to that dispatch which commerce demands, and the latter, in most instances, *impossible*, a standing Table for Days, in every state of confederation, becomes a mere *nullity*, or rather something worse, existing only to the prejudice of true calculation.

The commercial part of the kingdom may say, that a Table for Days is essential not only to the calculation of Interest, but also to the Discount of Bills drawn at *Days*, as is the usual run of *West-India* and *Inland Bills of Exchange*, but it does not appear that traffic is in any manner *benefited* by

by that mode of drawing ; whereas, it has been clearly proved to be thereby *injured*, tho' but in a small degree. There being therefore no *eligible* plea for drawing Bills at *Days*, any other method might be readily substituted, which would always proportion *time* to the given rate, and consequently return an Interest or Discount, without injury or loss to the parties concerned. If, for example, instead of 90 Days, a Bill was drawn at 3 Months ; or, instead of 21 Days, was drawn at 3 Weeks ; or, if drawn at  $2\frac{1}{4}$  Months, instead of 2 Months and 3 Weeks ; or, at 1 3-7ths, instead of 10 Days, &c. &c. the Interest would, in all these cases, be so nearly proportioned to the given rate, that the deficiencies, if any, would not be deserving notice.

I would not be understood to arrogate prescribed rules to the commercial world, nor of altering their present method of drawing Bills, and applying to the common Tables for Days, in seeking any required Interest, if they are resigned to the losses, which by Table IV. have been clearly shewn to arise from their use ; the intent of this Letter is only to produce facts, the consequences are submitted to those whom they may concern. Sufficient demonstration being therefore given of the injuries arising from the use of the common Tables, in their *independent* or *irrelative* state, I shall proceed to investigate the causes of their erroneous solutions in their congregate state, and the injurious effects therein produced on all calculations of Interest or Discount.

REMARKS  
ON THE  
CALCULATIONS OF TIME,  
IN ITS CONGREGATE STATE,  
AND THE  
ERRONEOUS INTEREST PRODUCED THEREFROM,  
WHEN THE  
CONFEDERATE INTEREST  
ARISING FROM MONTHS AND DAYS,  
IN THE COMMON INTEREST BOOKS,  
IS MADE THE SOLUTION TO ANY GIVEN PRINCIPAL.

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*THIS state of Interest, which calculates on Months, and the broken parts of a Month, being GENERAL in all official and commercial Standing Accounts, in all Accounts Current, calculations of Individual Property, and, indeed, in all cases where Time, in the first instance, is not restricted to Days, will be clearly proved to be defective, when calculated from the present Tables, or on the principles therein given.*

IN our Calendars the Days in a Year are divided into twelve parts, called Months ; in this division there arises a remainder of five Days, which being dispersed, make the number of Days in each Month indeterminate, but at the same time 365 Days are entirely comprised in the said twelve Months ; and, notwithstanding the *irregular* number of Days thereby given to each Month, the division by twelve *supposes them ALIQUOT*, and consequently exactly proportioned to each other.

It therefore follows in finding Interest for Days, that shall hold true concordance with that of Months, an aliquot proportion must also be maintained, and the Days in a Year in like manner be divided into twelve parts. In this division, thirty Days are given to each Month, which produce a remainder of five Days ; but such remainder, in the calculation of Interest for Days by vulgar Arithmetic, is constantly *omitted* ; whereas in the calculation on Months, the said five Days are constantly *included*, whereby the latter always produces an Interest for the time truly proportioned to the given rate ; while the former, by reason of such *deficiency*, is always *defective* in the amount of every required Interest.

The methods of computing congregate Interest by *vulgar Arithmetic*, may be digested under three classes, viz. First, by Years, Months, Weeks, and Days. Second, by Years, Weeks, and Days ; and Third, by Years, Months, and Days. In the

First Class, one Day is  $\frac{1}{4}$ th of  $\frac{1}{12}$ th of a Year.  
 Second Class, ditto  $\frac{1}{7}$ th of  $\frac{1}{52}$ d, - - or  $\frac{1}{364}$ th of a Year.  
 Third Class, ditto  $\frac{1}{30}$ th of  $\frac{1}{12}$ th, - - or  $\frac{1}{360}$ th of a Year.

It appears from this digestion of the classes, that the first makes the Year to consist of 336, the second 364, and the third 360 Days ; thus three denominators are seen to arise from *one* and the *same* integer, a known solecism in Arithmetic, for the year cannot consist of these homonymous parts, and produce equal solutions ; it is therefore necessary to *discover* which of these methods of calculation holds *true proportion* to [365], the Days in a natural Year, that therefrom a conclusion may be drawn to which a preference shall be given ; for this purpose, an investigation of the first class appears sufficient, the truth whereof being demonstrated, the fallacy of the other two must be immediately admitted, for they cannot disagree in their several denominators, and the value of their respective fractions be the same. Interest in the first class is always computed by *Practice*, and the Year consequently broken into *aliquot* parts, one Day being 1-7th of 1-4th of 1-12th of a Year ; this compound fraction produces the denominator 336, thereby creating an *assumptive Year* of 336 Days. This *aliquot* division of the *assumptive Year*, may, perhaps, create an opinion that Interest is proportioned to such *assumptive*, instead of to the *natural Year* ; but such opinion would be ill founded, for the *assumptive Year* will be shewn to be nothing more than a substitute or actuary, to prove the true proportion which the operations by the Rule of Three *should* bear to the *aliquot* calculations by the Rule of Practice, for as the Rule of Three, by vulgar Arithmetic, will always be found to *disagree* with the *aliquot* divisions by Practice, in all calculations of Interest, this *assumptive Year* becomes necessary not only to discover the cause of such disagreement, but to shew the means by which a true concordance may hereafter arise between the two methods of calculation.

But before this *most important evidence of the truth of an aliquot calculation* is brought forward, one plain leading question becomes necessary: *Why is the Rule of Three more eligible to the calculation of Interest, than the Rule of Practice?* It is well known the Rule of Practice is nothing more than an abbreviation and substitute of the Rule of Three, and such affinity is seen to exist in the two Rules, that the *one* is always used as a proof of the correctness of the *other*, whenever unity becomes the *first* term of a stating, which must constantly occur in calculating Interest for Days, whenever the Year is proportioned to the rate: In which case, the Year being brought into Days, to proportion the first term to the third, it may be asked, by what arithmetic process the said Year is discovered to contain 365 Days? *Reduction*, by which the operation must be performed, directs only two methods for this purpose, viz. a multiplication by 12, or by 13, to bring the given Year into Months; by 4, to bring the Months into Weeks, and by 7, to bring the Weeks into Days; the first process makes the Year consist of 336 Days, and the latter of 364: Hence it is plain, that 365 can be produced by no regular series in vulgar Arithmetic; and it is not only negatious, but puerile, to suppose that a denominator shall be multiplied into its own integer, to prove its existence; therefore the *radical powers* of Arithmetic, in no instance, justify a calculation by a divisor of 365, to find the Interest for Days, *truly proportioned to the broken parts of a Year*, though it may be admissible in finding the Interest for Days, in their independent or irrelative state, the denominator, in such case, being made *absolute*; but even then, the solutions are imperfect, as has been already demonstrated.

The aliquot calculations by *Practice*, suppose 336 Days to the Year, with which the operations by the *Rule of Three* are seen to agree ; but it may, notwithstanding, be objected, that if the Year is made the first term of stating, and reduced into Days, in the same proportion as are given the aliquot division by *Practice*, viz. by the *factors*, 12, 4, and 7, the same answer will be produced by the *Rule of Three*, as from the *Rule of Practice*, and therefore may both agree in their answers, and yet the solutions be *false* : This allegation is admitted, for unless the calculations, in either instance, are made by the known and acknowledged parts of the integer, the two operations may agree in the combination of their numbers, and at the same time be false in their principles ; for was a Shilling to be brought into Pence, and then into Farthings, and instead of *Twelve* there was only *Ten-pence* given to a Shilling, and *Six* Farthings to the Penny, instead of *Four*, the *Rule of Three* would exactly correspond with that of *Practice*, if the same *factors* were applied to both ; therefore the operations would agree in their *conclusions*, though evidently false in their *premises*.

I have introduced this remark to remove every objection which may arise to the proportion given the Year in the *Rule of Practice*, by an aliquot division of the Year, proportioned to 336 Days ; the great remaining question therefore is, If One Day is calculated as 1-7th of 1-4th of 1-12th of a Year, thereby *creating* an assumptive Year of 336 Days, the solutions arising therefrom are truly proportioned to [365] the Days in a natural Year ? for unless that can be demonstrated, the Interest produced from an aliquot division of the Year, by the *Rule of Practice*, *must be FALSE* ; it will therefore be clearly proved, that all calculations of Interest, proportioned to an assumptive Year of 336 Days, will amount

to exactly the same sum as will be produced from the natural Year of 365 Days, by the *Rule of Three*, when the third term of the stating is made aliquot to the first.

The division of the Year into 12 Months, for reasons already given, *supposes* 28 Days to the Month, and consequently 336 Days to the Year; notwithstanding, the Year so divided is clearly seen to contain exactly 365 Days, of which 30,4166 Days are in *reality* given the Month: These 30,4166 Days will speedily be shewn to hold exact proportion to the assumptive Month of 28 Days, being exactly 1-12th part of the natural Year; for One Month of 28 Days being also 1-12th part of the assumptive Year, the same ratio which 336 holds to 28, the Days in a Month of such assumptive Year, 365, will also hold to 30,4166, the Days in a Month of a natural Year, as appears from the following stating, and the answer produced therefrom:

$$\begin{array}{ccccccc} \text{Days.} & \text{Days.} & \text{Days.} & & & \text{Days.} & \\ \text{As } 336 : 28 :: 365 : 30,35-84, \text{ or } 30,416 = 1 \text{ Month.} & & & & & & \end{array}$$

In further evidence of the true proportion maintained in the two calculations, it shall appear that in finding the Interest on any number of *Days*, *proportioned to a Month*, the same answer will arise from a divisor of 336, by vulgar Arithmetic, as from a divisor of 365, when the third term of the stating bears true *aliquot* ratio to the integer, by the addition of the several required decimals, and be a clear testimony that to the *want of such aliquot proportion* in the *Rule of Three*, the amount of Interest in the common Tables, cannot agree with that produced by the *Rule of Practice*, nor the Interest for Days be compounded with Months, without always producing an answer less than the true amount.

In

In support of this fact, the following Tables are introduced, which demonstrate the Interest arising from the *Rule of Three*, when 336 is made the *first* term of the stating, and also when 365 is made the *first* term of the stating, the *third* term of each stating being, in both instances, made to bear an aliquot proportion to the *first*, whereby it will appear that the Interest on *Months*, *Weeks*, and *Days*, will always be the same by the one operation as the other.

## TABLE V.

Calculation by the Rule of Three, of the Interest of 100L at 5 per Cent. on the days contained in 11 progressive Months, of 28 days each; 336, the days in an *assumptive* year, being made the first term of each stating, viz.

As	Days.	£.	Days.	£.	s.	d.	
	336 : 5 :: 28 : 0	8	4				the Interest of 1 Month.
	336 : 5 :: 56 : 0	16	8				2
	336 : 5 :: 84 : 1	5	0				3
	336 : 5 :: 112 : 1	13	4				4
	336 : 5 :: 140 : 2	1	8				5
	336 : 5 :: 168 : 2	10	0				6
	336 : 5 :: 196 : 2	18	4				7
	336 : 5 :: 224 : 3	6	8				8
	336 : 5 :: 252 : 3	15	0				9
	336 : 5 :: 280 : 4	3	4				10
	336 : 5 :: 308 : 4	11	8				11

## TABLE VI.

Calculation of the Interest of 100l. at 5 per Cent. on the days contained in 11 progressive *Calendar* Months, by a divisor of 365, the days in a *natural* year, the auxiliary decimals being given, the third term of each stating.

<i>Days, £.</i>	<i>Third Terms.</i>	<i>Quotients.</i>	<i>Months.</i>
		£. s. d.	
As 365 : 5 ::	30,4191 : ,4167=0	8 4	Interest of 1
365 : 5 ::	60,8382 : ,8334=0	16 8	2
365 : 5 ::	91,2573 : 1,2501=1	5 0	3
365 : 5 ::	121,6764 : 1,6668=1	13 4	4
365 : 5 ::	152,0955 : 2,0835=2	1 8	5
365 : 5 ::	182,5 : 2,5 =2	10 0	6
365 : 5 ::	212,9337 : 2,9169=2	18 4	7
365 : 5 ::	243,3528 : 3,3336=3	6 8	8
365 : 5 ::	273,7719 : 3,7503=3	15 0	9
365 : 5 ::	304,191 : 4,167 =4	3 4	10
365 : 5 ::	334,6101 : 4,5837=4	11 8	11

## TABLE VII.

Calculation of the Interest on 100l. at 5 per Cent on 7 successive days, by the Rule of Three, and a divisor of 336, the days in an *assumptive* year, viz.

<i>Days.</i>	<i>£.</i>	<i>Day.</i>	<i>s. d.</i>	<i>Interest of 1 Day.</i>
As 336 : 5 ::	1 : 0	3 $\frac{1}{2}$		Interest of 1 Day.
336 : 5 ::	2 : 0	7		2
336 : 5 ::	3 : 0	10 $\frac{1}{2}$		3
336 : 5 ::	4 : 1	2		4
336 : 5 ::	5 : 1	5 $\frac{3}{4}$		5
336 : 5 ::	6 : 1	9		6
336 : 5 ::	7 : 2	1		7

TABLE

## T A B L E VIII.

Calculation of the Interest of 100l. at 5 per Cent. on 7 successive days, by a divisor of 365, the days in a *natural* year, with the auxiliary decimals given, the third term of each stating, viz.

Day.	£.	Third Term.	Quotient.	Value.	Day.
				s. d.	
As 365 : 5 ::	1,0877	:	,0149 = 0	3 $\frac{1}{2}$	Interest of 1
365 : 5 ::	2,12941	:	,02917 = 0	7	2
365 : 5 ::	3,19375	:	,04375 = 0	10 $\frac{1}{2}$	3
365 : 5 ::	4,25882	:	,05834 = 1	2	4
365 : 5 ::	5,4385	:	,0745 = 1	5 $\frac{3}{4}$	5
365 : 5 ::	6,3875	:	,0875 = 1	9	6
365 : 5 ::	7,6139	:	,1043 = 2	1	7

## T A B L E IX.

Calculation of the Interest of 100l. at 5 per Cent. on 3 progressive WEEKS, [48] the number of weeks in an *assumptive* year, being made the first term of each stating.

Weeks.	£.	Week.	s. d.	
As 48 : 5 ::	1	: 2	1	Interest of 1 Week.
48 : 5 ::	2	: 4	2	2
48 : 5 ::	3	: 6	3	3

## T A B L E X.

Calculation of the Interest of 100l. at 5 per Cent. on 3 progressive WEEKS, [52] the weeks in a *natural* year, being made the first term, and the auxiliary decimals given, the third term of each stating.

Weeks.	£.	Third Term.	Quotient.	s. d.	
As 52 : 5 ::	1,08368	:	,1042 = 2	1	Interest of 1 Week.
52 : 5 ::	2,16736	:	,2084 = 4	2	2
52 : 5 ::	3,25104	:	,3126 = 6	3	3

On

On reference to the preceding Tables, the reciprocal proportions which the answers bear to each other can no longer be doubted; hence a final and conclusive evidence arises, that as the assumptive year, in all calculations of Interest by the Rule of Three, bears a true proportion to the natural year. The Rule of Practice, though apparently calculating Interest to the assumptive year, of 336 days, in reality calculates to the solar, or natural year of 365 days; it therefore follows, that all ALIQUOT TABLES, composed from the Rule of PRACTICE, by the same divisions of TIME as are given the assumptive year, will always produce an Interest, for the given TIME, exactly proportioned to the given RATE, which no other operation by Vulgar Arithmetic can accomplish.

By the preceding Tables, it also appears that the proportioned deficiencies of the delinquent 5 Days, which must arise in each calculation by vulgar Arithmetic, are therein decimaly renovated in their several ratios, and arithmetically given the third number of each stating, in such aliquot proportions to the first, as to leave no remainders. This becomes another proof that the rejection of 5 Days, in dividing 365 into 12 parts, the disagreement of the Table of Days with that of Months, in the common Interest Books, is to be ascribed, and that imperfect amount of Interest which is always produced by their confederation.

It has been already shewn in Table III. that when the third term of a stating is already aliquot, the divisor 365, by the common operation of vulgar Arithmetic, will always produce an answer exactly proportioning the Interest to the rate, and to the given time, but the divisor 336, which in all other instances has been shewn to proportion the amount of Interest exactly to the Rule of Three, and the Rule of

Practice,

Practice, will, in this *state of TIME*, *agree with neither*. This fact will appear on the calculations of every *quintuple* in the revolution of 365 Days, of which mention has been already made, viz. 73, 146, 219, 292, and 365, (the last) finally immerses in the denominator.

The following calculation will first exhibit the amount of Interest of 100l. at 5 per cent. arising from each of these quintuples, by a divisor of 336.

	Days.	£.	Days.	£.	s.	d.
As	336 : 5 :: 73	:	1	1	8	$\frac{1}{2}$
	336 : 5 :: 146	:	2	3	5	$\frac{1}{4}$
	336 : 5 :: 219	:	3	5	2	
	336 : 5 :: 292	:	4	6	10	$\frac{3}{4}$

or 5l. 8s.  $7\frac{1}{2}$ d. per cent.

Hence it is plain, that the assumptive divisor 336, instead of producing Interest for the required time, proportioned to the given rate, when the third term of the stating is already aliquot to the first, will, on the contrary, increase the rate of 8s.  $7\frac{1}{2}$ d. beyond what it ought to be; but when the divisor 365, is made the *first* term of a stating, and these days, which are always aliquot to the year, made the *third*, the answer, by vulgar arithmetic, will be truly proportioned to the given rate, and exactly agree with the Rule of *Practice*, which it will not do in any other instance, without decimal assistance being given the third term, viz.

	Days.	£.	Days.	£.	s.	d.
As	365 : 5 :: 73	:	1	0	0	
	365 : 5 :: 146	:	2	0	0	
	365 : 5 :: 219	:	3	0	0	
	365 : 5 :: 292	:	4	0	0	

or 5l. per cent.

E This

This operation demonstrates that *unison* which should ever be maintained in the two calculations, and would in all instances agree where an aliquot ratio was reciprocally supported. In further evidence of this fact, it will appear by the following extract from the Aliquot Tables, lately published, that the Interest therein produced on the same time, exactly corresponds with the above calculations. An example from the first quintuple [73], may be sufficient for this purpose, viz.

73 Days are 1-5th of a natural Year; therefore,  
1-5th of a Year is 2 Months, 1 Week, 4 Days, and 1-5th.

		£. s. d.
Interest on 100l. at 5 per cent. for 2 Months	o 16 8	
1 Week	o 2 1	
4 Days, at $3\frac{1}{2}$ d. 2-7ths per Diem, is	o 1 2 $\frac{1}{4}$ 1-7th	
1-5th of 1 Day is	o - - - o o $\frac{1}{2}$ 4-5ths	
Answer	<u>£.1 0 0</u>	<u>33-35</u>

Thus the calculations by Practice, and the Aliquot Tables, are seen to hold exact proportion to those by the Rule of Three, when both the operations are aliquot to the given integer. This must be a *conclusive proof*, not only of the accurate proportion to the rate of Interest on all required time, produced by the Rule of Practice, but that the number 336, is neither *introduced*, nor *considered*, but as a demonstration that the *assumptive* Year is no other than a *substitute*, or *agent*, to confirm that true ratio which the Rule of Three ought to bear to the Rule of Practice, whenever the Table of *Days* are intended to be compounded with those of *Months*.

The same affections and dependencies, which have been proved in the Months and Days of the *assumptive* and the *natural*

*natural* Year, will also appear in the WEEKS; for in dividing the Year into 52 parts, *one Day remains*, consequently the division of the Year, in this instance, is not truly proportioned to 365 Days; therefore to maintain an *aliquot ratio to time and rate*, certain portions of the said Day will always be required to the *third term* of the stating, when 52 becomes the *first*, otherways an answer cannot be produced exactly proportioned to an aliquot division of the Year; this proportion is readily discovered by a common operation by the Rule of Three, when [48] the Weeks in an *assumptive Year*, will be seen to bear the same proportion to one *assumptive Week*, as 52, the Weeks in a *natural Year*, will bear to the aliquot proportion required for the *third term* of a stating, as appears in the following small specimen on three Weeks:

<i>Weeks.</i>	<i>Weeks.</i>	<i>Weeks.</i>
As 48 : 1 :: 52	:	1,08368
48 : 2 :: 52	:	2,16736
48 : 3 :: 52	:	3,25104

The decimals here introduced, and proportioned to an aliquot division of the Year, when given the *third term* of a stating, will produce an answer by a divisor of 52, exactly corresponding with that arising from the divisor 48, as appears on reference to Tables IX. and X.

The truth of an aliquot calculation being thus demonstrated, a doubt can no longer remain of the preference it holds to any other method, nor of the just proportion it bears, *in all instances*, to every rate of Interest; nor does any further evidence appear necessary to shew that the cause of the deficiencies in the amount of Interest produced by

the *common TABLES*, is by reason of the Months and Days not maintaining a concordant aliquot ratio to the same integer ; I shall therefore proceed to a manifest of the injurious effects which must hitherto have existed, and will continue to exist, in all calculations of Interest from the common Interest Books, or in such computations by the pen, as shall be made on the principles which are therein given.

No disagreement in the two methods of calculation will appear in the Years or Months, single or united, how varied so ever the *rate*, extended the *time*, or augmented the *principal sum* ; a difference will only be seen in computing the *broken parts* of a *MONTH*, the aliquot calculations by Practice, and those produced from the common Interest Books, being different in their principles. This disagreement will always manifest a loss of *FOUR-PENCE per cent.* on a clear average, and so in proportion to a greater or less sum. This average difference, as before observed, will be seen to proceed from the amount of Interest produced from the two methods of calculating the *broken parts of a MONTH*, a comparative statement whereof appears in the following Table of the Interest on 100*l.* at 5 per cent. on 28 progressive Days.

## TABLE XI.

Of the amount of Interest on 100l. at 5 per cent. for 28 progressive Days, extracted from the common Interest Books, and from the Aliquot Tables, lately published, with a comparative statement of the difference between the two calculations, viz.

COMMON TABLES.			ALIQUOT TABLES.			DIFFERENCE.	
Time.	Interest.		Time.	Interest.		s.	d.
Days.	s.	d.	W. D.	s.	d.		
1	0	3 $\frac{1}{4}$	0	1	0	3 $\frac{1}{2}$	0
2	0	6 $\frac{1}{2}$	0	2	0	7	0 $\frac{1}{2}$
3	0	9 $\frac{3}{4}$	0	3	0	10 $\frac{1}{2}$	0 $\frac{3}{4}$
4	1	1	0	4	1	2	0
5	1	4 $\frac{1}{4}$	0	5	1	5 $\frac{1}{2}$	0
6	1	7 $\frac{1}{2}$	0	6	1	9	0
7	1	11	1	0	2	1	0
8	2	2 $\frac{1}{4}$	1	1	2	4 $\frac{1}{2}$	0
9	2	5 $\frac{1}{2}$	1	2	2	8	0
10	2	8 $\frac{3}{4}$	1	3	2	11 $\frac{1}{2}$	0
11	3	0	1	4	3	3	0
12	3	3 $\frac{1}{4}$	1	5	3	6 $\frac{1}{2}$	0
13	3	6 $\frac{1}{2}$	1	6	3	10	0
14	3	10	2	0	4	2	0
15	4	1 $\frac{1}{4}$	2	1	4	5 $\frac{1}{2}$	0
16	4	4 $\frac{1}{2}$	2	2	4	9	0
17	4	7 $\frac{3}{4}$	2	3	5	0 $\frac{1}{2}$	0
18	4	11	2	4	5	4	0
19	5	2 $\frac{1}{4}$	2	5	5	7 $\frac{1}{2}$	0
20	5	5 $\frac{1}{2}$	2	6	5	11	0
21	5	9	3	0	6	3	0
22	6	0 $\frac{1}{4}$	3	1	6	6 $\frac{1}{2}$	0
23	6	3 $\frac{1}{2}$	3	2	6	10	0
24	6	6 $\frac{1}{4}$	3	3	7	1 $\frac{1}{2}$	0
25	6	10	3	4	7	5	0
26	7	1 $\frac{1}{4}$	3	5	7	8 $\frac{1}{2}$	0
27	7	4 $\frac{3}{4}$	3	6	8	0	0
28	7	8	4	0	8	4	0

The

The preceding Table discovers a difference, arithmetically progressive, of one Farthing on each increasing Day, contained in one Month, in each method of calculation, and demonstrates an average loss of *Four-pence per cent.* In the first six Days of each Week, the increase of a Farthing is seen on each Day's Interest, *in both calculations*; but at every *septuple*, each gives an additional Farthing, and thereby increases the difference one Halfpenny, which is caused by the daily approximation of each Day's remainder to its respective denominator. The aliquot calculation gives a remainder on one Day  $2\frac{7}{7}$ ths of a Farthing, which on the *seventh* becomes  $14\frac{7}{7}$ , equal to *one Halfpenny*, and had not this increase arisen on the Week, it would have been but 2s.  $0\frac{1}{2}$ d. instead of 2s. 1d. and the aliquot proportion thereby lost, which the Interest of the Week should bear to that of the Month; an increase of the fraction appears also in the column of *daily Interest* from the *common Tables*; for it is seen by Table II. that *one Day's Interest* gives the fraction  $\frac{55}{365}$ , which on the *seventh* becomes  $\frac{385}{365}$ , equal to *one Farthing*  $\frac{20}{365}$ , and makes the Week 1s. 11d. which, without such aggregation, would have been but 1s.  $10\frac{3}{4}$ d. This becomes another evidence of the accuracy of an aliquot calculation, which immerses, and consequently values, all the outstanding parts of the given rate.

The disagreement between the calculation of Interest in the **ALIQUOT TABLES**, lately published, and that which appears in the *common Interest Books*, is seen by these Tables to proceed from the *difference* and gradual increase of one Farthing on each Day's Interest, on the broken parts of a Month; which *difference* is readily reconciled, when it is *recollected*

recollected that the aliquot calculations by Practice, proportion the Interest of one Day to the Week, and the Week to the Month, whereas the calculations by the common Tables, proportion the Interest of one Day to 365, the Days in a Year; hence the difference is as 28 to 365, or 1-13th of a Day; and as the Interest for 1 Day, in the calculation by 365, is 3½d. or 13 Farthings, it is evident that if the said 13 Farthings are divided by 13, they will give the Farthing which appears wanting to make the calculations agree. But in a more familiar manner to remove every opinion which may remain that 3½d. 2-7ths, the amount of 1 Day's Interest, by Practice, is *meant*, or even *supposed*, a proportioned Interest to the annual rate, when the said rate is applied to 365 Days, the following plain evidence will be introduced to shew that 3½d. 2-7ths per Diem, is not proportioned to the Year, as containing the said 365 Days, but to the Months only; the Weeks bearing the same proportion to the Months, as the Months to the Year, and the Days the same proportion to the Weeks, as the Weeks bear to the Months; thus, by a gradual decreasing aliquot ratio, all the parts of the Year produce Interest exactly proportioned to the given rate.

It is readily seen that 3½d. 2-7ths per Diem, is exactly 2s. 1d. per Week, which is 8s. 4d. per Month, and 5l. per Annum; hence it is plain the said Interest for 1 Day on 100l. is *partial* only to a Month of 28 Days, whenever the Interest for Days shall be *compounded with that of Months*; for was it applied to a Year of 365 Days, it would make the annual Interest on 100l. 5l. 8s. 7½d. instead of 5l. and consequently the Interest for 1 Month, to correspond with that calculation, would be 9s. 0½d. and that of a Week 2s. 3½d. whereas it appears in the Aliquot Tables, and has been already

ready proved in every calculation by Practice, that  $3\frac{1}{2}$ d. 2-7ths per Diem, is exactly proportioned to an assumptive Year of 366 Days, which divides the Calendar into 12 Months, and the calculations by the assumptive Year, which corroborates those by Practice, having been *already proved* to hold true ratio to the natural Year, the amount of Interest on 1 Day, produced by Practice, and that produced by a divisor of 365, must always agree, or the *latter* must be erroneous, for reasons heretofore given, and confirmed by Table VIII. where it appears that 365, when proportioned to an aliquot division of the Year into 12 parts, produces  $3\frac{1}{2}$ d. the Interest for 1 Day, exactly corresponding with the assumptive calculation in Table VII. and with the *New Aliquot Tables*, produced by the Rule of Practice.

Thus every calculation gives additional evidence that the aliquot division of the Year, by the Rule of Practice, is truly proportioned to the natural Year of 365 Days; yet this method of dividing time has been mistaken by many as calculating Interest to the *Lunar Year*, by reason that 28 Days are thereby given to the Month; but was Interest calculated to the *Lunar Year*, it would make the amount of Interest still LESS than that produced by the common Interest Books; whereas the Aliquot Tables make the Interest MORE than the said Interest Books. The *Lunar Year* having 13 Months, gives but 7s.  $8\frac{1}{4}$ d. instead of 8s. 4d. for the Interest of one Month being  $7\frac{3}{4}$ d. less than the aliquot calculations, or than those of the common Books; on the contrary, the Interest for Days, proportioned to the *Lunar Year*, would be *greater* than that produced in the common Interest Books, by reason the divisor being but 364, the quotient will be increased in the proportion of the difference of the two divisors; hence the *Lunar Year* holds neither proportion

portion nor comparison with the one or the other of the Tables now in use; and in the more exaggerated computations will always make the Interest less than either. This fact will be more readily seen on comparing the amount of 100l. at 5 per cent. for 1 Month, 3 Weeks, and 5 Days, by the three different methods of computing time.

	£. s. d.	£. s. d.
The Aliquot Tables, by Practice, make 1 Month	0 8 4	
3 Weeks	0 6 3	
5 Days	0 1 5 $\frac{3}{4}$	
	<hr/>	0 16 0 $\frac{3}{4}$
Common Interest Books, by Rule of Three, 1 Month	0 8 4	
26 Days	0 7 1 $\frac{1}{4}$	
	<hr/>	0 15 5 $\frac{1}{4}$
Lunar Year, by Rule of Three, - - - 1 Month	0 7 8 $\frac{1}{4}$	
26 Days	0 7 1 $\frac{1}{2}$	
	<hr/>	0 14 9 $\frac{3}{4}$

This comparative statement of the amount of Interest by the three methods of calculation, is a clear, decisive, and undeniable proof that calculations of Interest by Aliquot Tables, or by the common Interest Books, have not the least concordance, affinity, or retrospect to the Lunar Year.

The causes, effects, and *average loss of FOUR-PENCE per cent.* on all Interest Accounts, calculated from the common Interest Books, being demonstrated, it may not be uneligible to point out *some* of the national evils which must follow a perseverance in their use; in order to which I shall first introduce the following comparative statement of an Interest Account, wherein the difference will plainly appear which arises from the two methods of calculation.

Statement of the Amount of an Interest Account, calculated by ALIQUOT TABLES.

Statement of the Amount of an Interest Account, calculated by the Common Interest Books.

Principal Sum.	Time.	Interest.	Principal Sum.	Time.	Interest.	Principal Sum.	Time.	Interest.	Principal Sum.	Time.	Interest.
£. 4500	M. W. D.	£. 36 16 8	£. 4500	M. D.	£. 35 7 10 $\frac{1}{2}$	£. 4500	M. D.	£. 35 7 10 $\frac{1}{2}$	£. 4500	M. D.	£. 35 7 10 $\frac{1}{2}$
7300	1 3 5	89 1 6 $\frac{1}{2}$	7300	1 2 26	86 16 8	7300	1 2 26	86 16 8	7300	1 2 26	86 16 8
2550	1 3 2	19 7 1	2550	1 2 23	18 13 2 $\frac{1}{4}$	2550	1 2 23	18 13 2 $\frac{1}{4}$	2550	1 2 23	18 13 2 $\frac{1}{4}$
8500	1 3 4	67 0 10	8500	1 2 25	64 10 6 $\frac{1}{4}$	8500	1 2 25	64 10 6 $\frac{1}{4}$	8500	1 2 25	64 10 6 $\frac{1}{4}$
7750	2 3 6	95 14 5	7750	2 2 27	93 4 11 $\frac{1}{2}$	7750	2 2 27	93 4 11 $\frac{1}{2}$	7750	2 2 27	93 4 11 $\frac{1}{2}$
6550	1 3 3	50 13 11	6550	1 2 24	48 16 6 $\frac{1}{4}$	6550	1 2 24	48 16 6 $\frac{1}{4}$	6550	1 2 24	48 16 6 $\frac{1}{4}$
4750	1 2 6	33 18 7 $\frac{1}{4}$	4750	1 2 20	32 16 1	4750	1 2 20	32 16 1	4750	1 2 20	32 16 1
2150	2 2 6	24 6 4 $\frac{1}{2}$	2150	2 2 20	23 16 1 $\frac{1}{4}$	2150	2 2 20	23 16 1 $\frac{1}{4}$	2150	2 2 20	23 16 1 $\frac{1}{4}$
3650	1 3 5	29 6 8	3650	1 2 26	28 4 2	3650	1 2 26	28 4 2	3650	1 2 26	28 4 2
2300	1 3 6	18 16 5	2300	1 2 27	18 1 9 $\frac{1}{4}$	2300	1 2 27	18 1 9 $\frac{1}{4}$	2300	1 2 27	18 1 9 $\frac{1}{4}$
£. 50000											

Total Difference £. 14 14 7 $\frac{3}{4}$

\* By this Statement it appears, that on the Interest of 50,000, there is a difference of 14l. 14s. 7 $\frac{3}{4}$ d. in favor of the Aliquot Calculations by Practice, and consequently determines a loss to that amount from the use of the common Interest Books. The average in this Statement, instead of FOUR, is about SEVEN-PENCE per cent. This increase per centum, will be seen to proceed from the approximation of the broken parts of the several Months to 28 Days. From this evidence of the loss attending an Interest Account on the above sum, a proportioned deficiency must be allowed to arise on all Interest Accounts, at what rate soever they may be computed, when the broken parts of a Month are nearly the same as given in this Statement. *Discrimination would require a volume*, but this partial Statement is an undeniable proof, that every *Public Company, Government Department, or Funded Property*, that should require a Daily Interest on various sums, amounting in the aggregate to 50,000, the loss sustained by the present mode of computing Interest, allowing 31 $\frac{1}{3}$  Office Days to the Year, would amount to FOUR THOUSAND FOUR HUNDRED AND FIFTY ONE POUNDS, TWO SHILLINGS AND FIVE-PENCE !!!

The *Bank of England*, in a more particular manner, must be injured by the common method of computing Interest, not only in their Interest Accounts, but in all cases of Discount, *Commerce* must also experience a similar *loss*. The *Public Funds*, officially considered, can receive no injury by their calculations of Interest, by reason their dividends are periodical, at six Months and six Months, whereby the amount of all Interest being calculated on *time*, bearing aliquot ratio to the Year, the amount will always be proportioned to the given rate; therefore the *Stock-holder* can never suffer by his receipts of the periodical Dividends; but he will constantly be injured in all instances of *Transfer on Sale of Stock*, the amount of Interest from the common Books on *outstanding Time* not being truly proportioned to that rate of Interest at which the Stock is valued, as will appear by the following

## C A S E.

A. orders B. his Broker, to sell out 100l. 5 per cents. on which there appears to be 1 Month and 3 Weeks outstanding Interest, which Interest by the common Interest Books, is 14s. 1d. and by the Aliquot Tables, 14s. 7d. therefore if B. pays A. 14s. 1d. only for the outstanding time, he pays him Six-pence *less* than he ought to receive, it not being truly proportioned to the rate per cent. he would have been paid, had the Stock remained until the Dividends became due in regular course; whereas, on the contrary, it will be seen that 14s. 7d. the Interest he ought to have received, will be exactly proportioned to 5l. the allowed Interest per cent. per ann.

## PROOF.

<i>M. W.</i>	<i>S. D.</i>	<i>Months.</i>
If 1 3	14	7 12
4	12	4
—	—	—
7	175	48
	48	
	—	—
	1400	
	700	
	—	—
	7)8400	
	12)1200	
	—	—
	20)100	
	—	—
	<u>£.5</u>	Answer.

This concordance of the Aliquot Tables, with the actual rate of Interest arising from *Funded Property*, being demonstrated, the discordance of the Interest in the common Interest Books, on all outstanding time, to the prescribed rate, will next be shewn. These Books make the Interest of 1 Month and 21 Days 14s. 1d. This heterogeneous extract, instead of being proportioned to 5l. cannot, by *Vulgar Arithmetic*, be proportioned to any rate at all, except the same series are applied as have already been given in the preceding aliquot calculations; which series, instead of producing 5l. at which the Stock is known to be valued, will give but 4l. 16s. 6 $\frac{3}{4}$ d. as appears by the following stating:

If

<i>M. D.</i>	<i>£.</i>	<i>s.</i>	<i>d.</i>	<i>Months.</i>
If 1 21	0	14	1	12
4		12		4
4		169		48
7		336		7
49		1014		336
		507		
		507		

49) 56784 (1158 6-7ths, or 4l. 16s. 6 $\frac{3}{4}$ d. per cent.

$$\begin{array}{r}
 49 \dots \\
 \hline
 \cdot 77 \\
 49 \\
 \hline
 288 \\
 245 \\
 \hline
 \cdot 434 \\
 392 \\
 \hline
 \cdot 42
 \end{array}$$

There is no other method by *Vulgar Arithmetic*, of working the above stating, for it is a known axiom in the Rule of Three, that the first and third terms must be brought into one denominator, before either can be compounded with the second; and there is no regular series of numbers by which the operation can be performed, than what has been before given, for we cannot give other than 4 Weeks to the Month, and 7 Days to the Week; and if 13 Months were given to the third term, the calculation would be *Lunar*, the third term 364, and the Interest deficient in the like proportion: An assumptive Year is therefore plainly demanded in an operation by the Rule of Three, to proportion the amount of Interest to that rate, which would, and ought to have arisen from an aliquot calculation of the natural Year, by the

the Rule of Practice, which alone proportions the Interest to the given rate; for 14s. 1d. the given Interest of 1 Month and 3 Weeks, by the common Tables, instead of being proportioned to 5l. the known Interest of the Stock per ann. is demonstrated by the Rule of Three to produce but 4l. 16s. 6 $\frac{1}{4}$ d.

The principle on which the Interest is formed in the common Tables, and applied to calculation in this case, may be deserving notice: It makes 1 Month 8s. 4d. which is truly proportioned to 5l. the known rate per ann. which implies a divisor of 336 by the Rule of Three, as already shewn; this being done, application is made to the Table of Days, which makes the Interest of 21 Days 5s. 9d. which is proportioned to 4l. 19s. 11 $\frac{1}{4}$ d. per cent. and the calculation by the Rule of Three gives 365 as a divisor; thus, in this operation, *two* rates per cent. are produced, *two* integers are implied, *two* divisors given, and the Year made to consist of *two* different number of Days.

On perusal, Sir, of these various facts, your wisdom and discernment will clearly discover the loss per cent. which has hitherto arisen, and will continue to arise on every species of calculation of Interest from the common Tables now in use; *the evil at present pervades the whole Kingdom*; in what manner it may deserve reform, or the interference of Government, is most respectfully submitted to your judgment and decision. Vanity, Sir, has no share in this address; I resign popular fame to youthful ambition, too old to rise, and too obscure to be noticed, the only gratification I can hope from a disclosure of this nature, is the satisfaction of having at least endeavonred to render *general benefit*; but flagrant as the proofs appear, it does not follow that Incorporations, or  
the

the Commercial World may receive them ; custom, and inflexible opinion may determine *one* part of mankind to continue in that method, to which they have been long accustomed ; but while, with due deference, I acknowledge their discretionary powers to continue *defrauding themselves*, by persevering in the use of the present Interest Books, I am inclined to believe that partial opinions cannot be a precedent for general proceedings, or the mere egotisms of the few, regulate the minds of the many ; it may therefore be inferred, that some part of mankind will be inclined to embrace that method of calculating Interest which is supported by demonstration, in preference to that which has nothing to defend it ; and as the election is merely optional, neither having statute or common law to authorise a preference, every man will conceive his undoubted right to pursue that method which to him may appear most eligible ; the consequences are obvious, confusion and continual altercation will arise from two methods of calculating Interest being thus publicly given to the Kingdom, of which the following few Cases will not only be sufficient evidence, but a convincing proof that a total abrogation of the one or the other becomes indispensible.

#### C A S E I.

A. orders B. his Broker, to sell 7000l. five per cents. on which there is 1 Month and 3 Weeks Interest outstanding. B. estimates the Interest for the time by the common Interest Books, 49l. 6s. 0½d. A. on the contrary, finds by the New Aliquot Tables, that the Interest thereon is 51l. 0s. 1d. making a difference of 1l. 14s. 9½d. which B. refuses to allow. Query---Which is right ? they cannot be *both* right.

*right, and disagree in their totals; and by what process can A. compel B. to pay the difference?*

**C A S E II.**

Two Merchants, A. and B. settle an Account Current; A. produces the Account Current, wherein is an Interest Charge, amounting to 116l. 14s. 9d. taken from the New Aliquot Tables. B. examines his common Interest Book, and finds the amount only 104l. 6s. 4d. making a difference of 12l. 8s. 5d. in favor of A. This difference B. refuses to allow, on which A. brings it to issue. *Query---What law or precedent can direct the Jury? or if referred to arbitration, who shall give the award? Merchants may plead usage, but they cannot refute demonstration.*

**C A S E III.**

A. has a legacy of 10,000l. bequeathed him, payable three weeks after the death of the Testator, bearing Interest at 5 per cent. B. the Executor, tenders 28l. 15s. 4d. the Interest of the money bequeathed, calculated from the common Interest Books. A. refuses this tender, alledging, the Interest by the New Aliquot Tables is 31l. 5s. od. making a difference of 2l. 9s. 8d. B. hereupon produces his book, and declares that 21 Days are equal to 3 Weeks, and therefore 28l. 15s. 4d. is the money. A. thereupon produces his book, and shews that 3 Weeks amount to 31l. 5s. od. *Query---How shall this difference be reconciled to the parties?*

**CASE**

## C A S E IV.

A. orders a Broker, B. to purchase 1000l. East India Bonds, on which there is 2 Months, 3 Weeks, and 3 Days outstanding Interest, at 3 per cent. which by the Aliquot Tables, B. finds to amount to 7l. 2s. 10 $\frac{1}{4}$ d. A. by his common Interest Book, finds the amount to be only 6l. 19s. 5 $\frac{1}{2}$ d. making a difference of 3s. 4 $\frac{3}{4}$ d. which A. refuses to allow. Query---In what manner can B. recover the difference he paid on purchasing the Bonds?

## C A S E V.

The Bank of England, or any private Bank, has a Bill of 100l. tendered for Discount, which has 1 Month, 3 Weeks, and 3 Days to run, the current Discount, (which, according to the *present method*, is equal to the Interest on the outstanding time) is by the common Tables 14s. 10 $\frac{1}{4}$ d. but by the Aliquot Tables 15s. 5 $\frac{1}{2}$ d. whereby it clearly appears that a loss of Six-pence Three Farthings per cent. arises on the *same time* on all monies so discounted by the common Tables of Interest; and was Ten Thousand Pounds to be daily discounted, at the same *time* and *rate*, the loss thereby would be 2l. 16s. 3 $\frac{1}{2}$ d. per diem.

These partial proofs lead to a general idea of the loss which has arisen, and will continue to arise, from the present method of calculating Interest on Money, a loss more readily conceived than described; and though the difference of Four-pence per cent. in the average, may, in the first instance, appear too trifling for notice or correction, when confined to small sums, yet, when applied to OFFICIAL CALCULATIONS, where the aggregate sums are large and

various, it will be found to demand serious regulation. The OFFICE of ENQUIRY, and CHANCERY ACCOUNTANTS, may, perhaps, have frequent opportunities of experiencing the fact. The BANK of ENGLAND, and every private BANK, in all cases of DISCOUNT, will be convinced of the injuries they have many years sustained by the method they have been accustomed to pursue, when the annual aggregate difference is exhibited in the two methods of calculation; nor will the Counting-house of the MERCHANT and AGENT be longer insensible of the advantages which must hereafter arise to their capitals, by the use of Aliquot Tables, or future calculations of Interest by the Rule of Practice only.

The CASES, Sir, which I have the honor to submit to your perusal, are undeniable evidence of what may be expected to arise from *two methods* being given the public of calculating Interest on Money: The proofs I have here adduced, in support of an *Aliquot Calculation*, are so numerous and so clearly demonstrated, that a doubt can no longer remain of the exact proportion it bears to every given *time* and *rate*; while, on the contrary, the Tables now in use, have nothing advanced in vindication of this truth, but the mere egotism of the respective Authors.

Supported by the clear evidence of NUMBERS, I hope to stand excused in confidently affirming, that no operation by *vulgar Arithmetic*, but an aliquot calculation by the *Rule of Practice*, can ever produce an Interest for *time*, exactly proportioned to the given *rate*, when such *time* is composed of *Months*, and the *broken parts of a Month*; and in all instances where *time* is so divided, the Interest arising for *Days*, from a divisor of 365, will never confederate, or truly unite, with that of *Months*, but on the contrary, *will always make the Interest*

*Interest less than the real amount ; and until some more able Accountant shall bring public arithmetical evidence to the contrary, a tacit acknowledgement must follow, that what I have the honor to advance in this LETTER, cannot be REFUTED.*

Notwithstanding the advantages held forward to the Public, by the introduction of these Aliquot Tables, there are many who may still persevere in that method, to which they have been long accustomed ; but while no laws appear necessary to compel that part of mankind to alter their present mode of calculation, which entitles them to LESS than they have a right to demand, nor compulsory statute to oppose their determined resolution to thereby continue *defrauding themselves* ; the more enlightened part of the kingdom, who shall be open to conviction, and appear inclined to avail themselves of the advantages arising from an **ALIQUOT CALCULATION**, cannot but look forward to your wisdom and protection for that **LEGAL aid and assistance**, which the justice of their future claims may appear to demand.

I have the honor to be, &c. &c.

*Speedily will be published,*

# T A B L E S O F LEGAL DISCOUNT,

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THESE Tables will be the first introduced in these Kingdoms to Public Notice: The common Tables of Interest, appear to have hitherto answered all the Purposes of the *present or current method of DISCOUNT*, which calculates Interest on the amount of the Bill, or other deposited Security; which Interest is retained as the Premium, or Recompence, for the PROMPT, or *Money paid*:— Whereas **LEGAL DISCOUNT** is the receiving Interest on the Money *actually advanced*, in proportion to the *time and rate*, at which it is *really lent*: this latter method, on which these Tables are formed, gives the **BANKER**, or other Discouter *FIVE per cent.* the allowed, and known premium to which he is entitled; whereas, by the former method, it is arithmetically demonstrated that *TEN per cent.* is received, being *FIVE per cent.* more than the *Legal Interest* of the Kingdom. Submitted to the consideration of those whom it may concern.

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BY WILLIAM WALLACE,  
AUTHOR OF THE NEW ALIQUOT TABLES OF INTEREST.